Space Weather Technical Forecast

Issued on Saturday, 12 November 2022 at 12:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of further M-class flares (R1-R2/Minor to Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with one M class flare from AR3141, observed at 12/0018 UTC. There are three numbered regions on the visible disc. AR3141 is the most significant region on the visible disc, it remains a complex region with large complex spots, with a weak Delta configuration less evident in recent hours. AR3140 has seen further minor spot emergence on its southern flank. The remaining region, AR3145, remains weak with two small spots. No Earth-directed CMEs have been observed on available imagery. A CME was observed lifting off from the southeastern limb around 11/1700 UTC.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, saw an increase from slow-ambient at around 330 km/s to slightly elevated with levels now reaching around 470 km/s. Density has shown some variability with near average levels predominantly and a mostly downwards trend observed . Total magnetic field strength (IMF) was mainly moderate, with levels peaking at 14 nT at 11/2226 UTC. The north-south component, Bz, was weak to moderate and fluctuated between +11/-11 nT. Phi angle has been negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2 MeV) at GOES-16 has generally been at background to moderate levels, with a brief incursion into high levels peaking at 1140 pfu at 11/1655 UTC. Electron fluence levels remained below Active levels with further falls in levels and the observed fluence at 12/0001 UTC was 1.98e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be generally Low, with a chance of further isolated M-Class flare activity. The most likely source of activity is from the largest and most complex region AR3141 Eki/Beta-Gamma.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently forecast, although a CME was observed lifting off from the southeastern limb around 11/1700 UTC, and modelling and analysis of available imagery shows this could give a glancing blow later on day 3 or early on day 4 (14 and 15 November).. Solar winds are currently at slightly elevated levels, and may become a little more enhanced in coming hours to reach elevated levels for a time. Thereafter a return to slow-ambient levels over the next couple of days is likely as HSS effects wane. On day 4 (15 November), a further weak coronal hole enhancement to solar winds is possible. Geomagnetic activity is expected to be mainly Quiet to Unsettled (Kp 0-3) with a slight chance of Active (Kp 4) intervals especially on day 4 (15 November).

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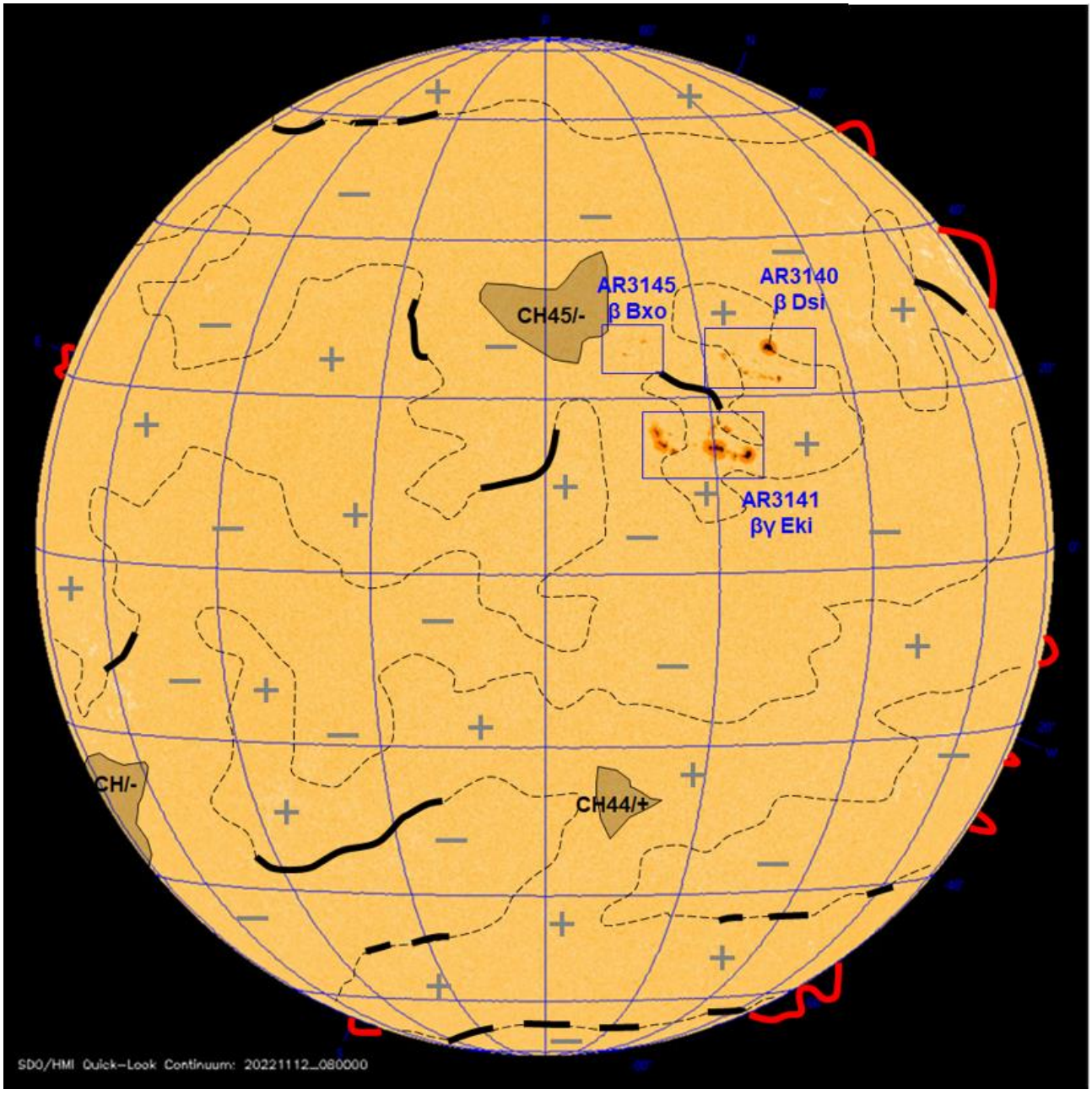
Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) observed by GOES-16 is expected to remain at background levels. There may be a slight increase in the probability of solar radiation storms later in the period. Electron flux is forecast to be at background to moderate levels throughout the period, perhaps exceeding the high threshold during the next couple of days at diurnal peak. Fluence values are expected to remain below Active throughout the period.

Figure 1. Solar Analysis Valid 0800 UTC, 12 November 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

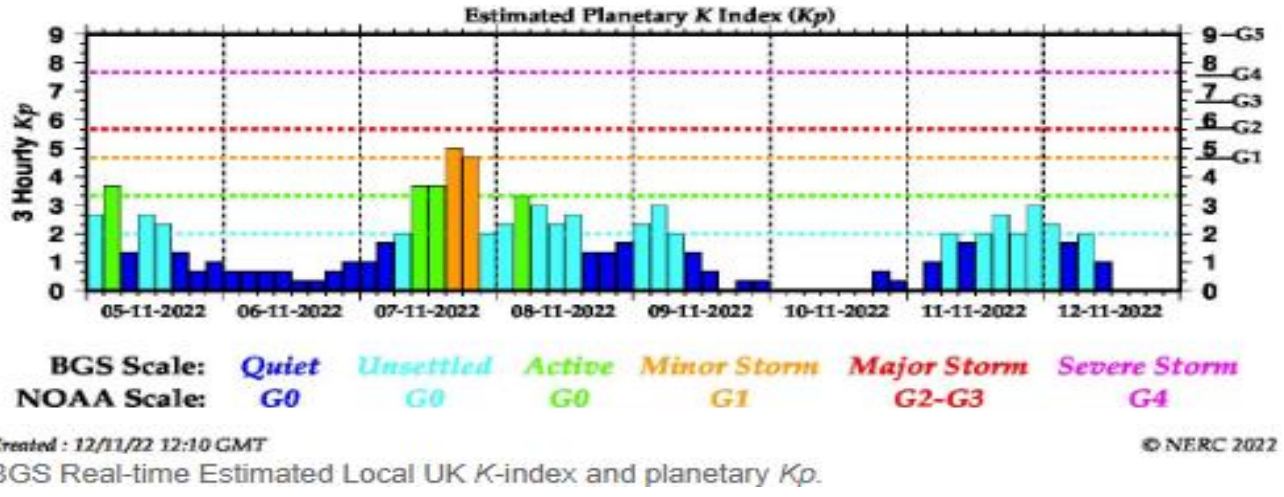
No Earth-directed CMEs are currently forecast, although a CME was observed lifting off from the southeastern limb around 11/1700 UTC, and modelling and analysis of available imagery shows this could give a glancing blow later on day 3 or early on day 4 (14 and 15 November). Solar winds are currently at slightly elevated levels, likely a result of a weak coronal hole connection. Winds are expected to return to slow-ambient levels over the next couple of days as HSS effects wane, however in the next few hours solar winds may reach elevated levels for a time.
There are two small coronal holes on the visible disc, CH45 in the northern hemisphere and CH44 in the south. CH45 is expected to rotate into a geoeffective position around day 4 (15 November), at which point a further weak enhancement to solar winds is possible.
Geomagnetic activity is expected to be mainly Quiet to Unsettled with a slight chance of Active intervals. Generally Quiet conditions then likely to prevail through days 2 and 3 (13 & 14 November), before possible weak coronal hole influence by day 4 (15 November), combined with possible CME arrival effects brings a slight chance of Active intervals, and a very slight chance of G1 conditions if the CME has larger impacts.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: BGS Magnetomter data over the past few days showing geomagnetic activity.



BGS Real-time Estimated Local UK *K*-index and planetary *Kp*.

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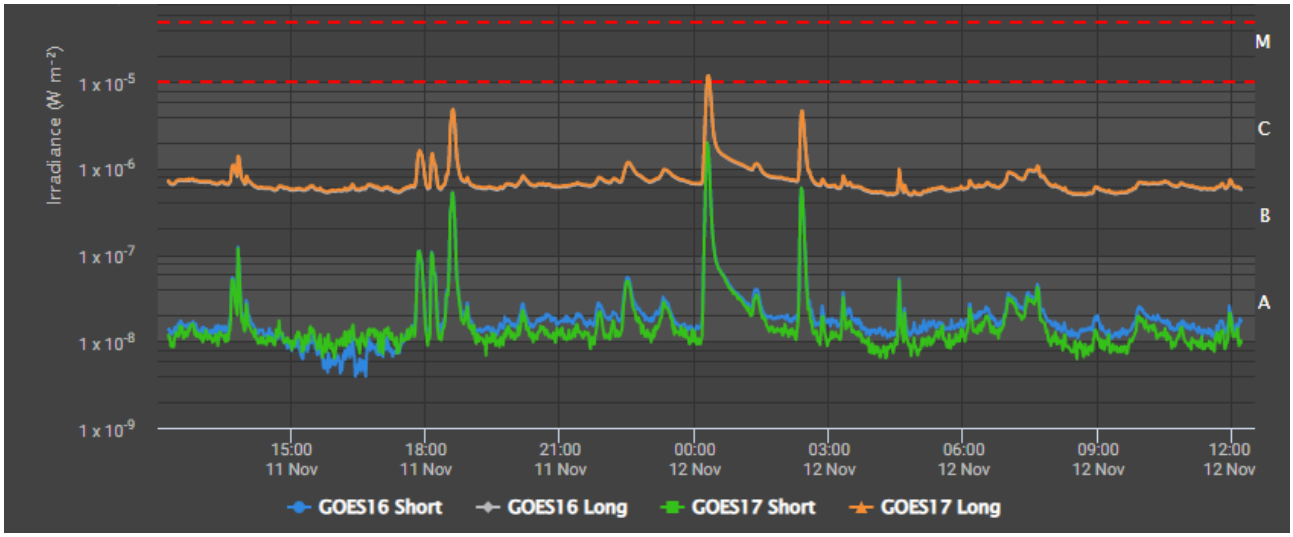
Radio Blackouts - X-Ray Flares:
Solar activity is likely to be generally Low, with a chance of further isolated M-Class flares. The most likely source of activity is from the largest and most complex region AR3141 Eki/Beta-Gamma. The remaining regions on the visible disc are less likely to produce significant flares. Two further returning active regions are due to potentially rotate across the limb over the coming days and these regions may additionally contribute to the overall flare risk, with probabilities lifted a little in the table above by day 3 (14 November).

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	Yes	40	40	50	50
Very Active	**R3 to R5 X Class**	No	5	5	5	5

Figure 3: X-ray flux plot at GEO from GOES data source in past 24 hours, showing single M-class flare at 0018 UTC.



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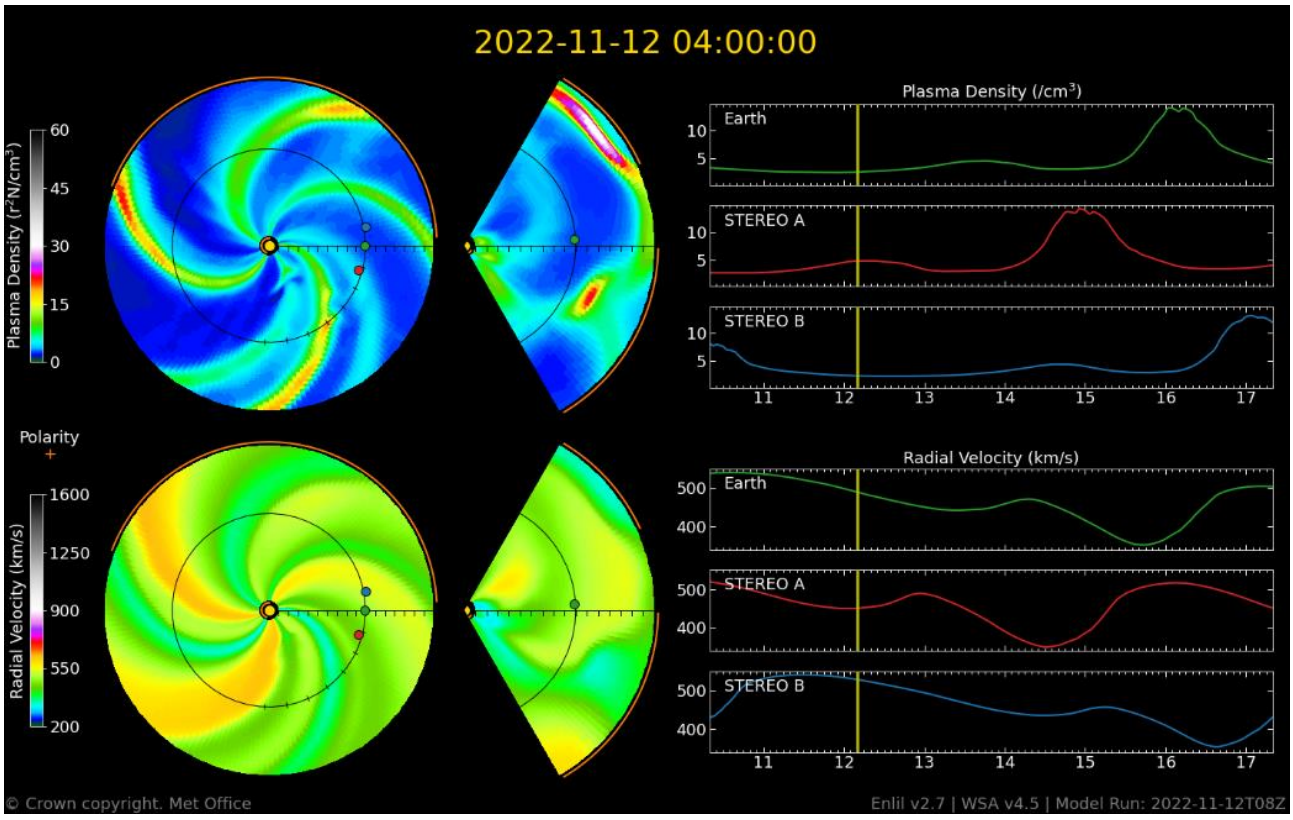
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) at GEO, observed by GOES-16 is currently at Background levels and is forecast to remain at this level throughout the period. As AR3141 transits into a more geoeffective position there is a slight increase in the probability of proton storms, however, this is on the assumption that the spot remains complex in configuration.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	10
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: Met Office ENLIL model output, giving an indication of HSS arrivals.



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High Energy Electrons Event (≥ 2MeV):
Electron flux (greater than 2MeV) is currently at Background to Moderate levels. Electron flux is forecast to remain at predominantly Background to Moderate levels through the period. For the remainder of day 1 (12 November), there is a chance of briefly approaching or exceeding the High threshold (1e3 pfu) during a diurnal peak, and this is possible also for day 2 (13 November),
Electron fluence values are below the Active (1e8 integrated pfu) threshold and are expected to remain so throughout the period, with a largely flat trend most probable. The MOSWOC REF Model currently supports electron fluence values remaining below the 1e8 Active threshold, however, model confidence in absolute values beyond day 2 (13 November) is low.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: High energy electron flux at GEO and Met Office REFM output.

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